Indian River Lagoon- South Project

Lessons Learned in Applying Cost Effectiveness and Incremental Cost Analyses

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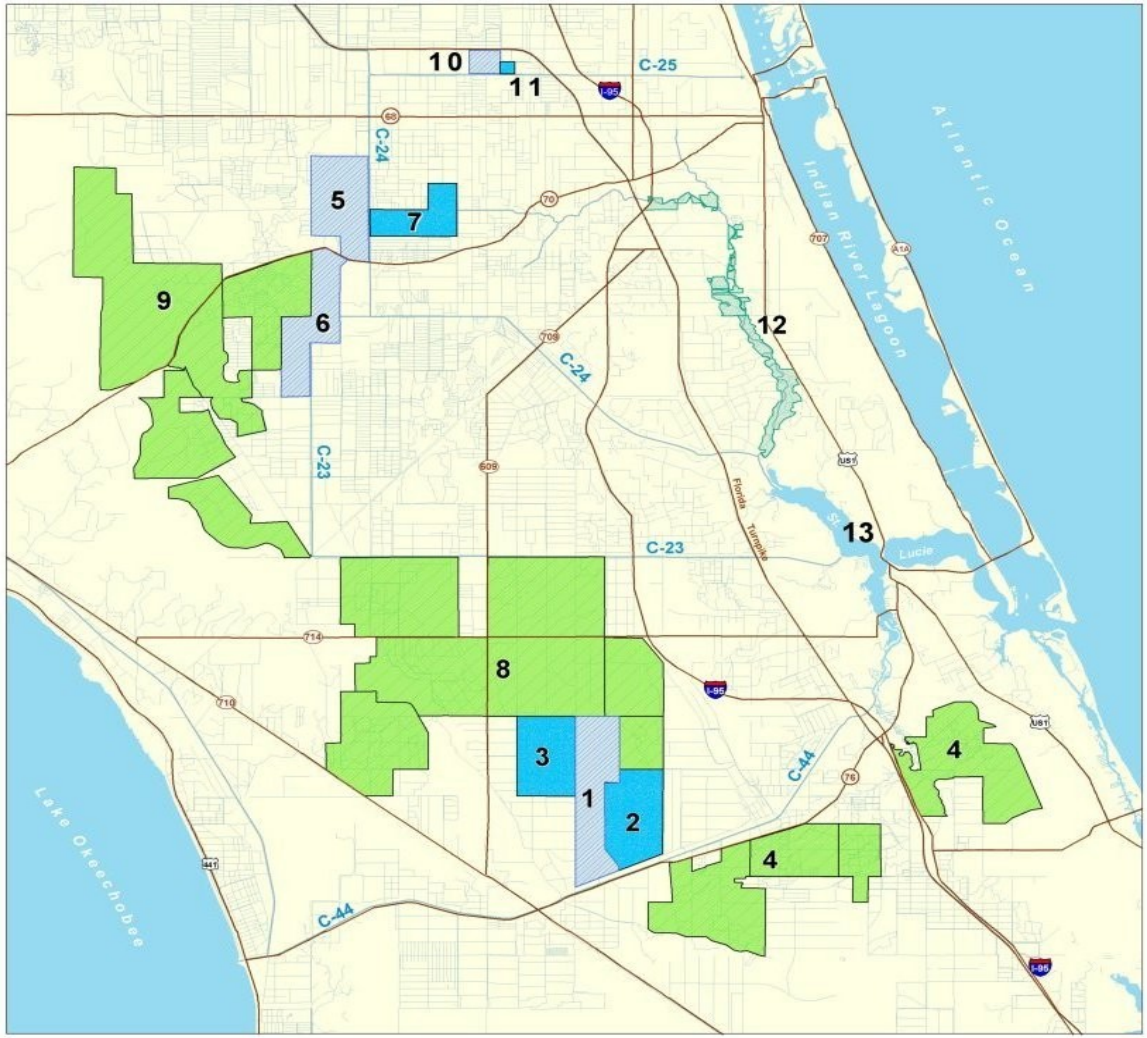
the journey to restore America's Everglades

Indian River Lagoon - South Area Map



C-44 Basin Components

1 C-44 - Reservoir
2 C-44 - Stormwater Treatment Area(East)
3 C-44 - Stormwater Treatment Area(West)
4 Palmar Complex - Natural Storage and Water Quality Area

C-23/24 Basin Components

5 C-23/C-24 - North Reservoir
6 C-23/C-24 - South Reservoir
7 C-23/C-24 - Stormwater Treatment Area
8 Allapattah - Complex Natural Storage and Water Quality Area
9 Cypress Creek/Trail Ridge Complex - Natural Storage and Water Quality Area

C-25, Northfork and Southfork Basin Components

10 C-25 - Reservoir
11 C-25 - Stormwater Treatment Area
12 Northfork Natural Floodplain Restoration
13 Muck Remediation and Artificial Habitat

Natural Floodplain Restoration
Natural Storage and Water Quality Area
Reservoir
Stormwater Treatment Area

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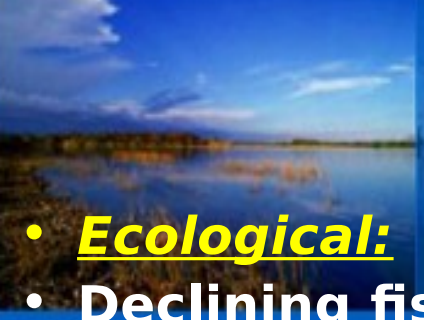
Miles



IRL-S Problems & Opportunities

- ***Ecological:***
- Declining fisheries resources, fish kills & lesions
- Accumulation of unconsolidated sediments (muck)
- Extensive & frequent algae blooms
- Decline of submerged aquatic veg (SAV), oyster reefs
- Decline in spatial extent & functional quality of watershed wetlands & native upland/wetland mosaic
- ***Water Quality:***
- High freshwater discharges disrupting salinity regime
- Pattern/location of freshwater discharges
- Eutrophication (excessive P & inorganic N)
- ***Economic & Social Well-Being:***
- Irrigation demand
- Resource-based recreation & tourism
- Commercial & recreational fisheries

Problems: Water Quality

Problems: Water Quantity

…too much

…too little

Problems: Timing & Hydroperiod

Wrong timing of flows

Ditched and drained wetland systems

IRL-S Objectives & Constraints

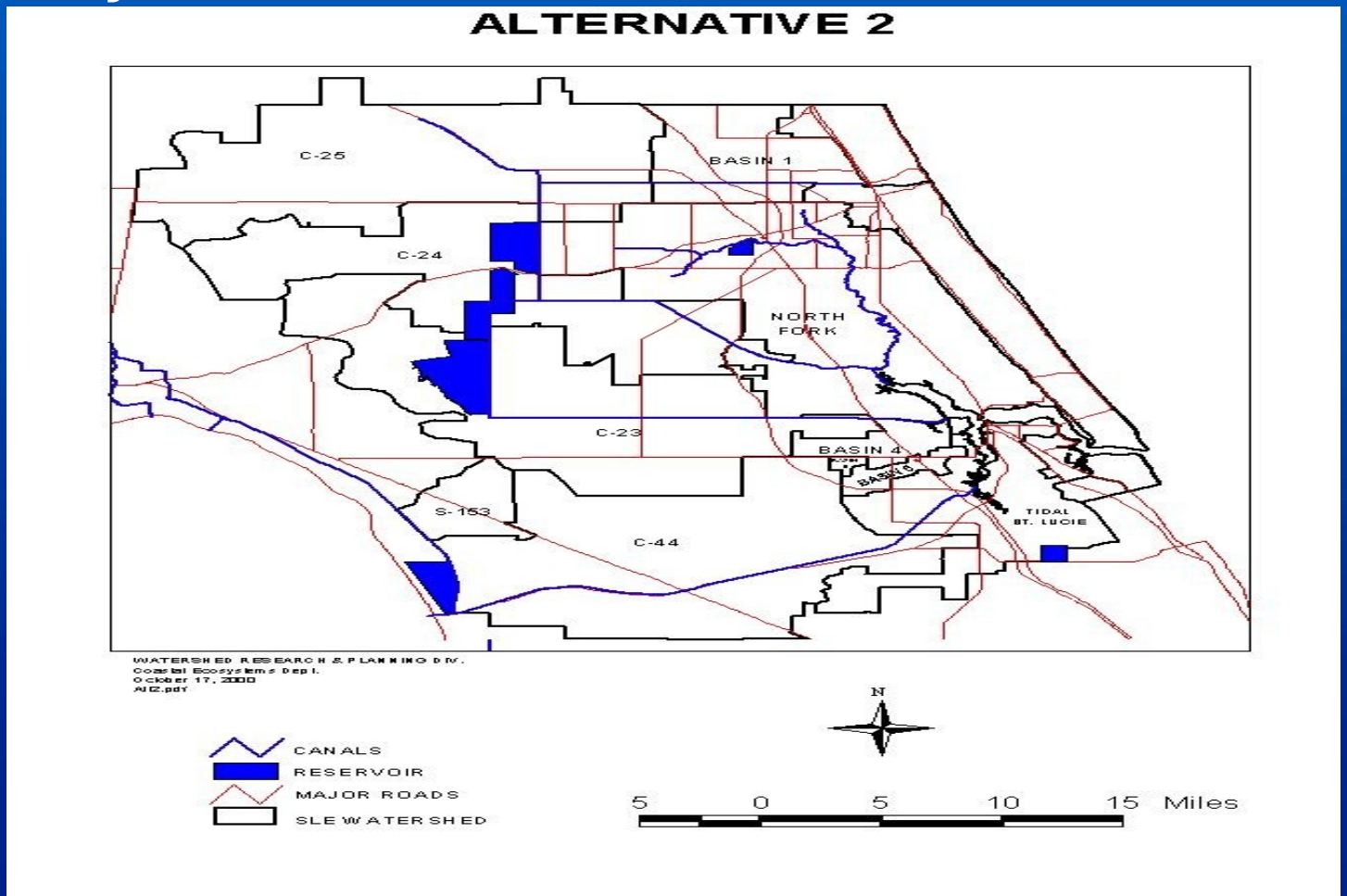
- ***Restore Ecological Values:***
- **Re-establish a natural pattern of freshwater flows to the St Lucie Estuary (SLE) & Indian River Lagoon (IRL)**
- **Improve water quality in the SLE and IRL**
- **Improve habitat for estuarine biota**
- **Increase spatial extent & functional quality of watershed wetlands & native upland/wetland mosaic**
- **Increase diversity & abundance of native plant & animal species, including threatened & endangered species**
- ***Improve Economic Values & Social Well-Being:***
- **Increase water supply**
- **Maintain existing flood protection**
- **Improve opportunities for tourism, recreation, & environmental education**
- **Improve commercial & recreational fisheries**

Development of Alternative Plans

- ***Potential features/components:***
- **Reservoirs for above ground storage of freshwater runoff**
- **Stormwater treatment areas (STAs) for water quality treatment of captured flows**
- **Restoration of historic native upland/ wetland habitat**
- **Natural areas for storage of freshwater runoff**
- **Natural areas for water quality treatment**
- **Enhanced estuarine habitats utilizing artificial habitat methods**
- **Muck remediation in the SLR & SLE**
- **Hydrologic diversions within the watershed to mimic historic/ natural flow patterns**
- **Enhance estuarine health through restoration of North Fork of the SLR**

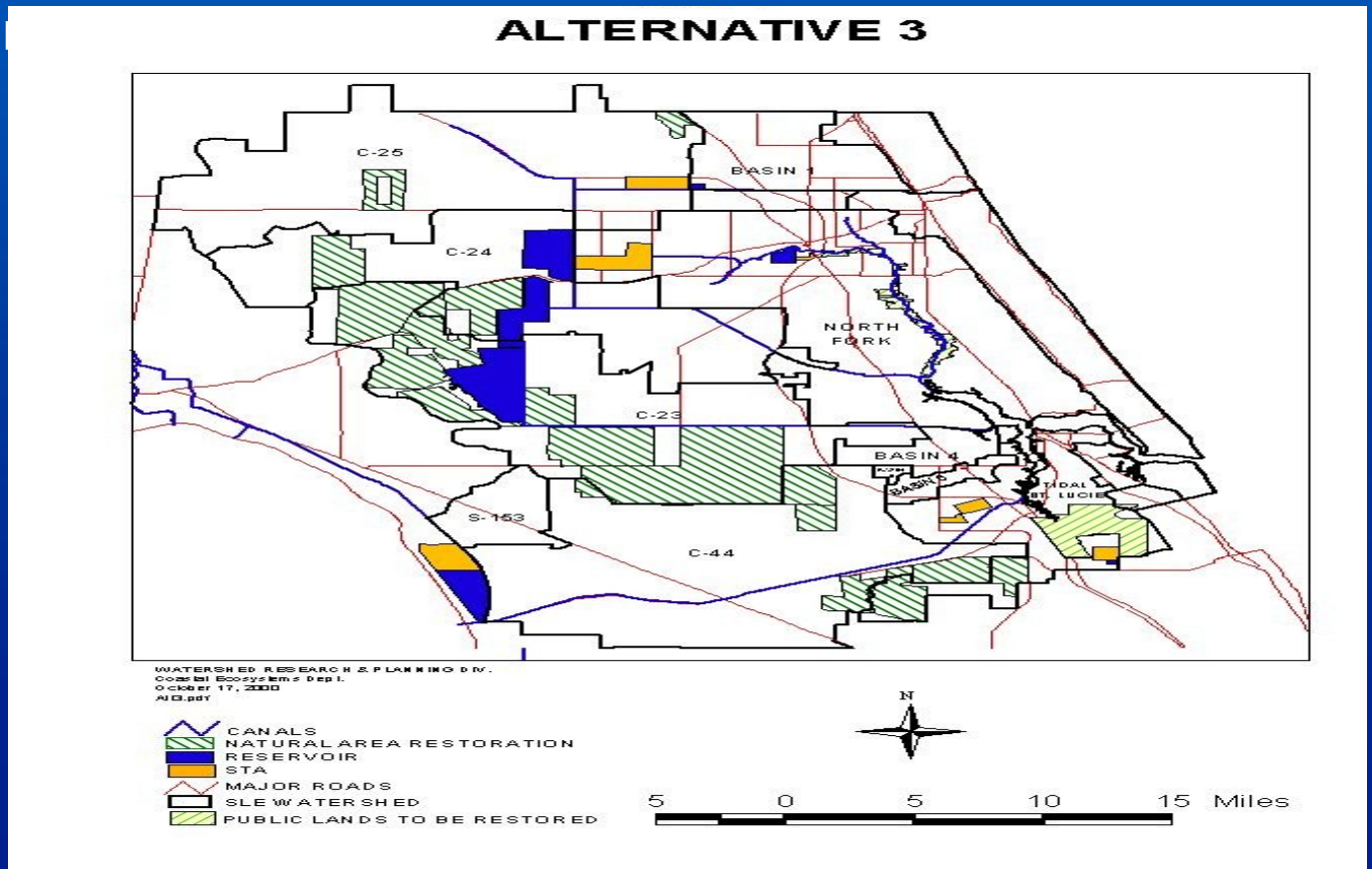
Indian River Lagoon – South Alternatives

- **Alt 2 – “Yellow Book” Alt - above ground storage only (C-44, C-23/24 and C-24 Reservoirs)**



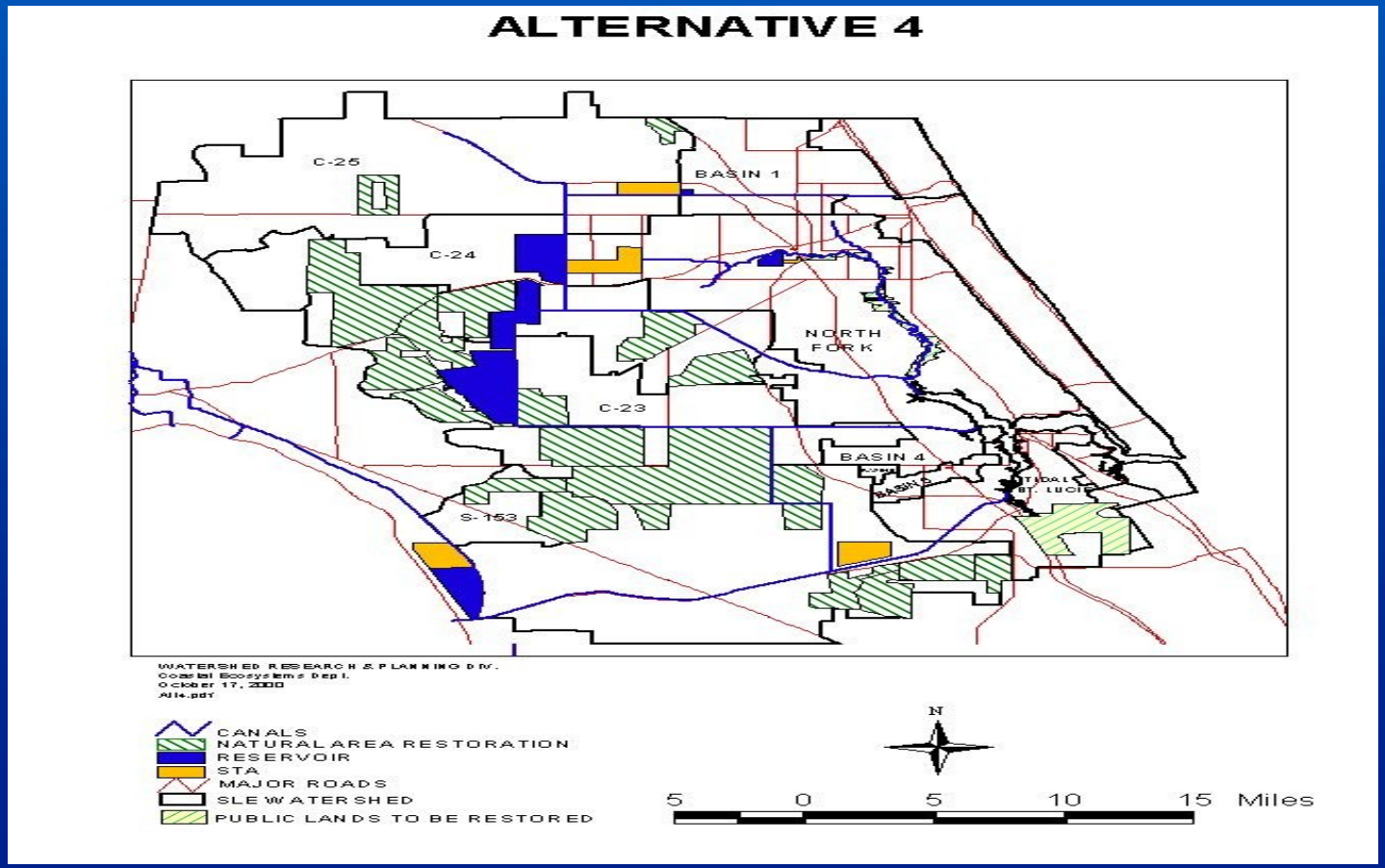
Indian River Lagoon – South Alternatives

- **Alt 3 - Combination of single purpose plan (reservoirs, STAs, and pumping to divert flows from C-23/C-24 to the North Fork of St. Lucie Estuary,**



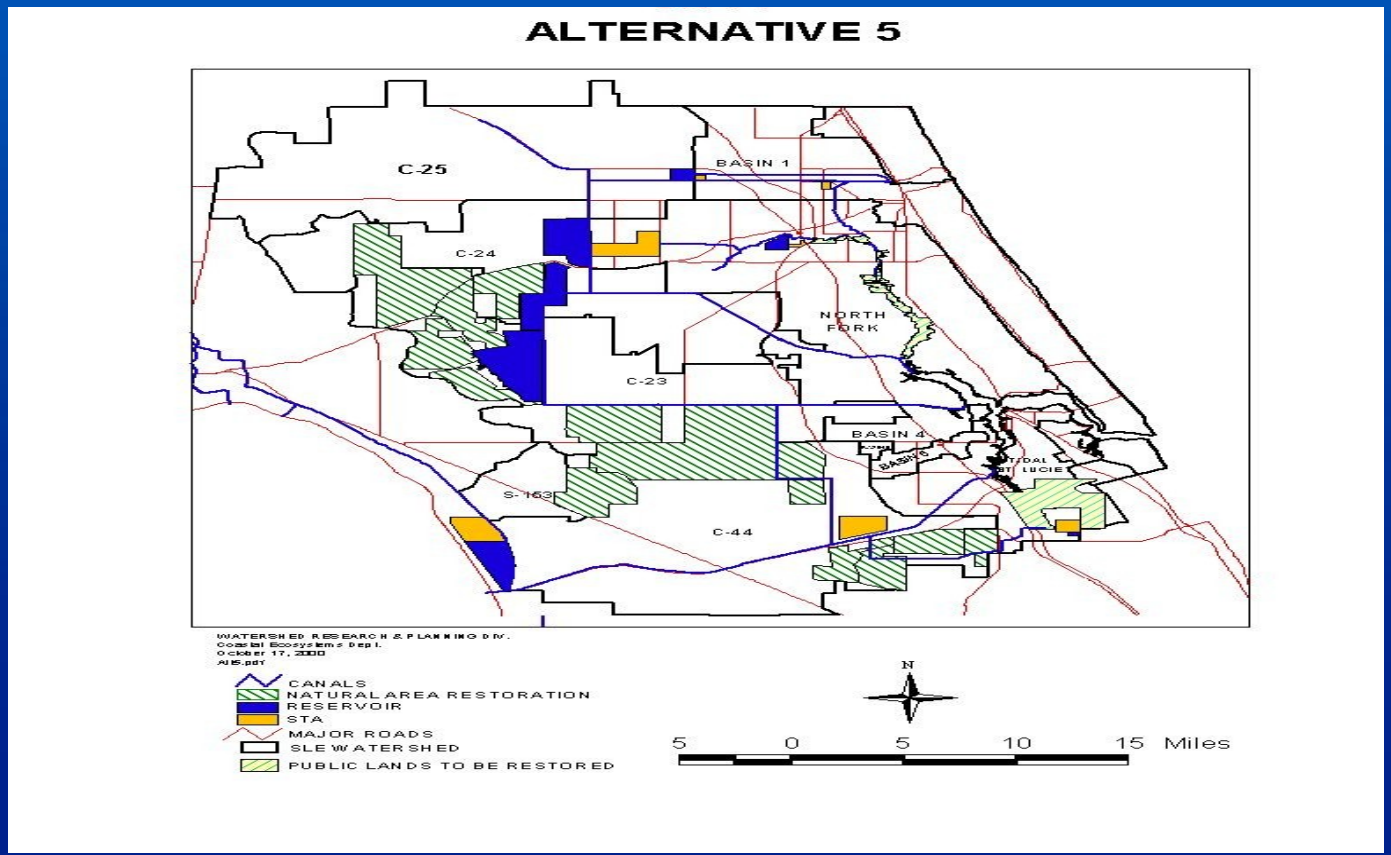
Indian River Lagoon – South Alternatives

- **Alt 4 – Improved water quality & diversion (additional STAs, greater natural storage areas, & muck removal)**



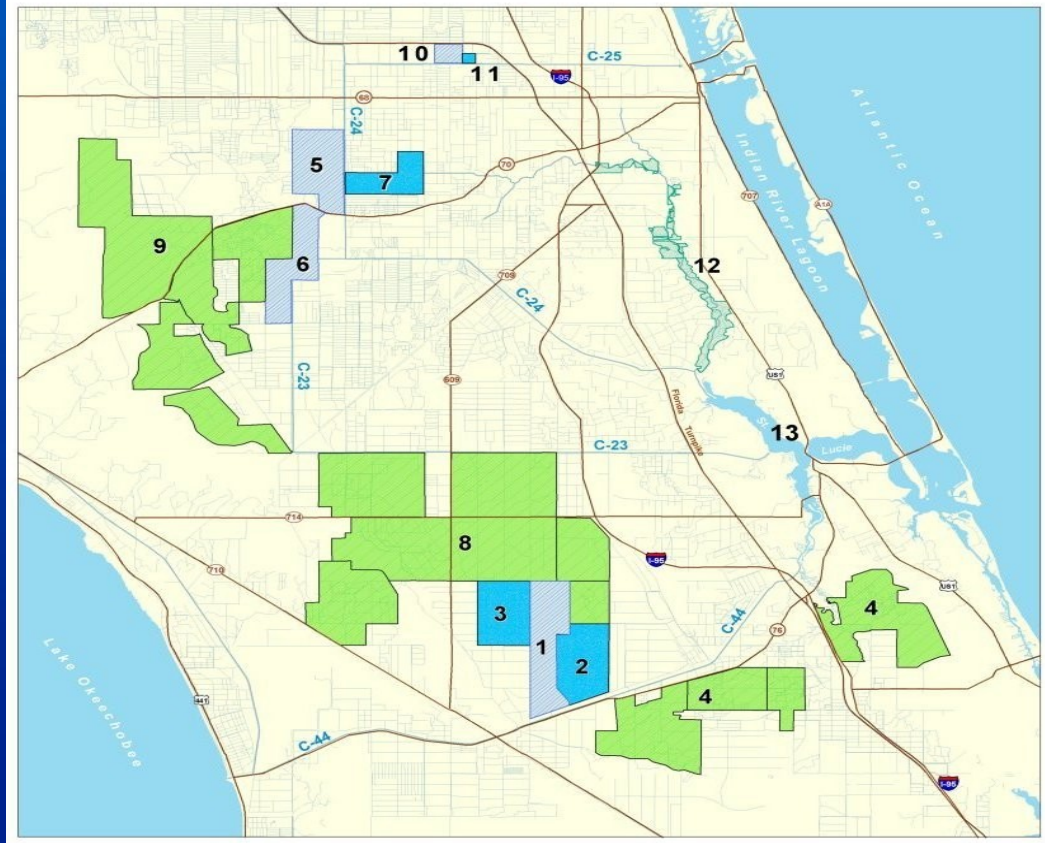
Indian River Lagoon – South Alternatives

- **Alt 5 – Additional improvements to water quality & diversion (additional water quality treatment of run-off), reduced natural areas**



Indian River Lagoon – South Alternatives

- **Alt 6 (Recommended Plan) – additional refinements to Alt 5 (+ storage, - STA's, other features =)**



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Natural Floodplain Restoration
Natural Storage and Water Quality Area
Reservoir
Stormwater Treatment Area

0 1 2 4 6 8 10
Miles

IRL-S Issues & Lessons

- ***Issue:*** **How to evaluate alternatives on multiple performance measures, multiple outputs?**
- ***Strategy:*** **Linked habitat unit indices to performance measure achievement, conducted multiple analyses, developed combined metrics, weighted "primary" output**
- ***Lesson:*** **Importance of output metric in portraying results (CE/ICA) & justifying plan selection**

Cost Effectiveness & Incremental Cost Analyses

- **For each alternative:**
  - Average annual equivalent costs
  - Average annual outputs:
    - Oyster habitat units
    - Benthic habitat units
    - SAV habitat units
    - Wetlands requiring 100% restoration habitat units
    - Wetlands requiring 50% restoration habitat units
    - Uplands habitat units
    - Combined estuary habitat units
    - Combined watershed habitat units
    - Estuary & watershed combined index (normalized)
    - Estuary & watershed combined index (normalized & estuary given four times the weight)
  - Calculated both for with & without “rest of CERP” conditions, with-CERP portrayed in following slides

IRL-S Issues & Lessons

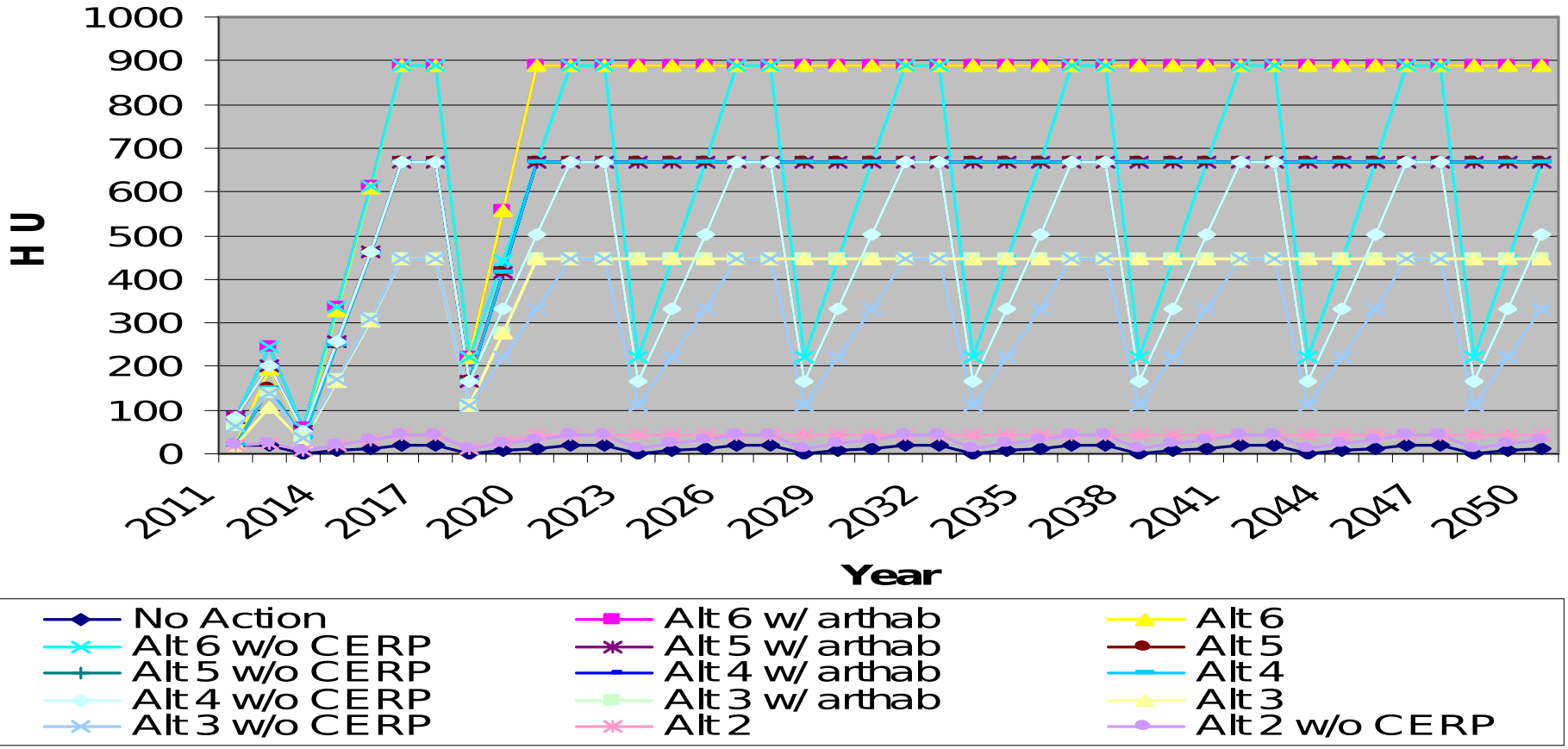
- ***Issue:*** **How to evaluate ecosystem outputs over time?**
- ***Strategy:*** **Developed "average annual habitat units"**
- ***Lesson:*** **Not a 2050 "snapshot", avg. annual units can have surprising results**

Average Annual Habitat Unit Calculations

- Required by ER1105-2-100, E-6c.(1)
- Calculated for 6 resource types (oysters, SAV, benthic, wetlands 100%, wetlands 50%, uplands)
- HU's estimated for existing condition (2003), first year of project operation (2011), future with- & without-project condition (2050), & all intervening years
- Differences between with & without summed for all years, then divided by # years to yield "average annual value"
- Different assumptions for each resource regarding w/o project conditions, ecological response rates, effects of Lake O damaging discharges, effects of other CERP projects ("interim benefits"), etc.

Communicating Results: IRL-S Oyster HU's With & Without Other CERP Projects

Figure 6-D. Change in Estuarine Oyster Habitat (HU's) over Period of Analysis

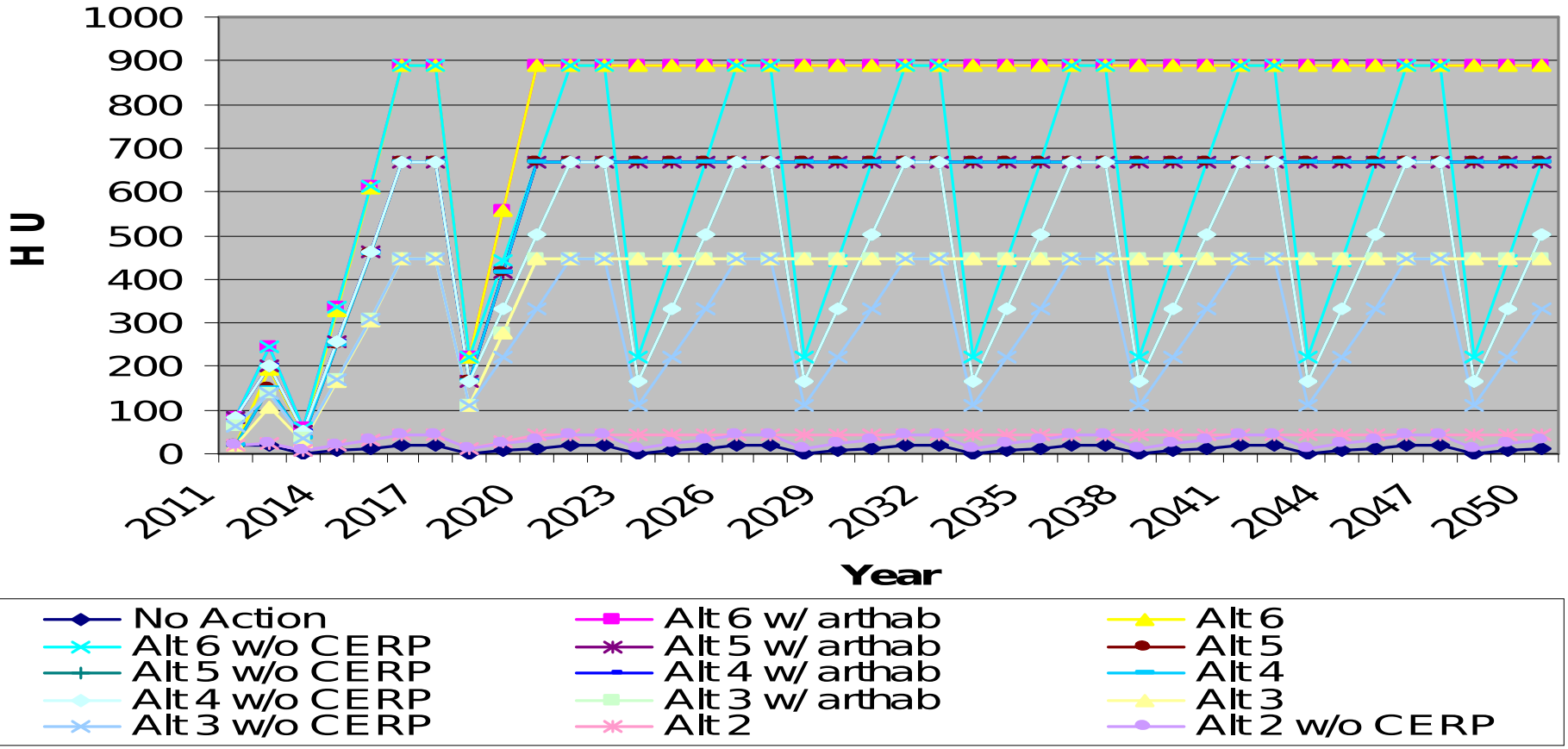


IRL-S Issues & Lessons

- ***Issue:*** **How to account for dependency on other CERP projects?**
- ***Strategy:*** **Developed outputs for 2 conditions: w/ "rest of CERP" (system analysis) and w/o "rest of CERP" (interim/ next-added increment analysis). IRL-S passed test… fortunately!**
- ***Lesson/ Issue?:*** **CERP Pro Regs call for justification of alternative for both conditions**

Communicating Results: IRL-S Oyster HU's With & Without Other CERP Projects

Figure 6-D. Change in Estuarine Oyster Habitat (HU's) over Period of Analysis



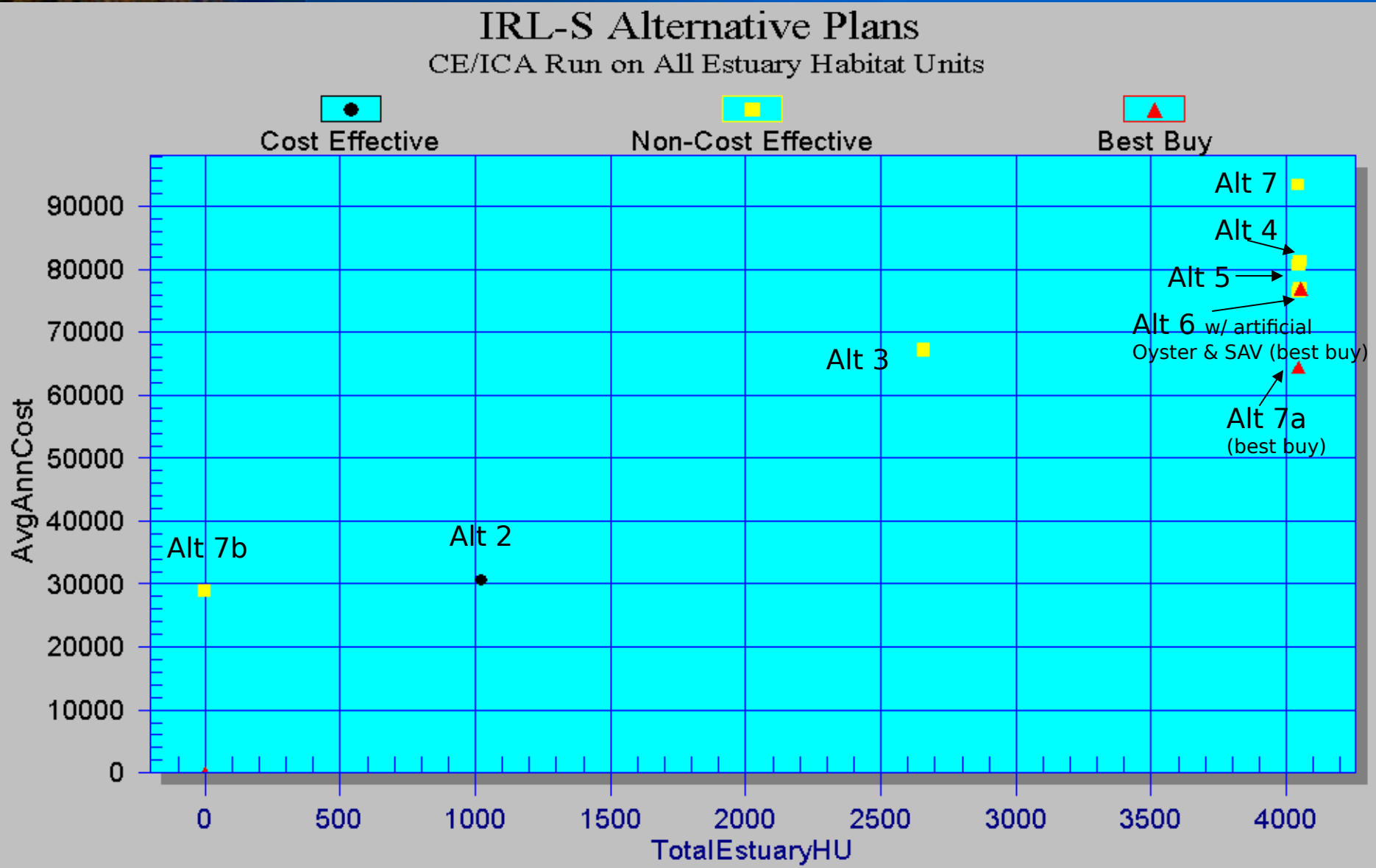
IRL-S Issues & Lessons

- ***Issue:*** **Need to show costs & outputs for discrete management measures (features) & scales**
- ***Strategy:*** **Not originally fully addressed, but developed new alternatives ("estuary-only", "watershed only", & combo of 2) to bridge the gap & demonstrate synergy of recommended plan. Also broke out a few separable, small features, where possible.**
- ***Lesson:*** **Higher authority will continue to ask for "bracketing"/ scaling of features/ alts. To the extent possible, document costs & outputs of features/ management measures separately. Consider smaller & larger scales. Keep record of features that are screened out.**

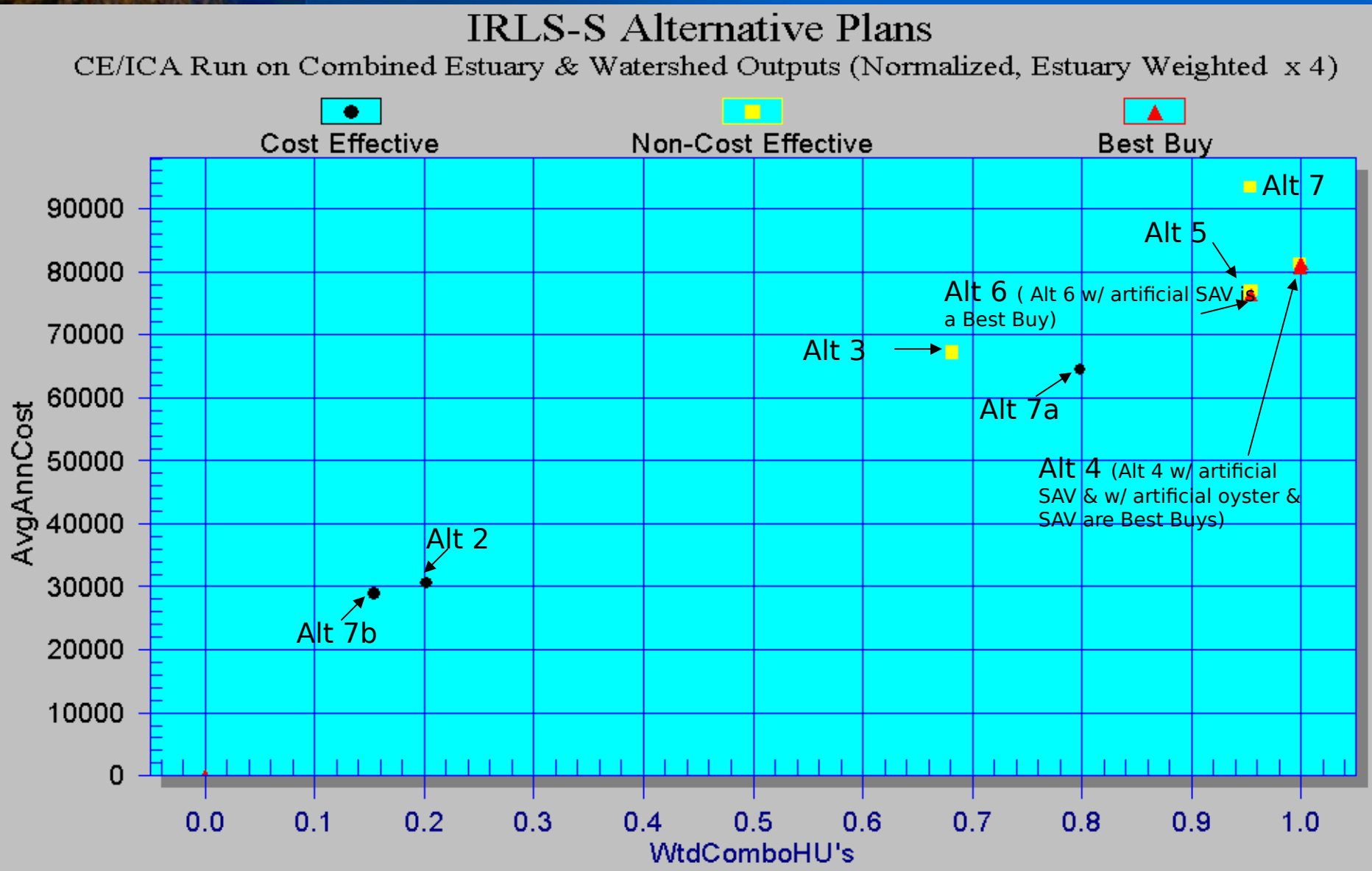
IRL-S Costs & Outputs Used for CE/ICA

	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7a	Alt 7b	Alt 7
Variable								
Average Ann. Cost ($1,000)	$30,594	$67,000	$80,622	$76,379	$76,320	$64,501	$28,909	$93,378
Cost w/ Art Oyster Habitat	NA	$67,315	$81,252	$77,009	$76,951	NA	NA	NA
Cost w/ Art SAV Habitat	NA	$67,002	$80,626	$76,383	$76,325	NA	NA	NA
Cost w/ both Art Habitats	NA	$67,317	$81,256	$77,014	$76,955	NA	NA	NA
Oyster AAHU's	192	505	771	771	771	771	0	771
Artificial Oyster Habitat	0	3	3	3	3	0	0	0
SAV AAHU's	204	517	783	783	783	783	0	783
Artificial SAV Habitat	0	3	5	5	5	0	0	0
Benthic AAHU's	628	1,635	2,491	2,491	2,491	2,491	0	2,491
All Estuarine AAHU's	1,024	2,663	4,053	4,053	4,053	4,053	0	4,053
Wetlands 100% AAHU's	0	14,361	23,791	27,699	27,699	0	27,699	27,699
Wetlands 50% AAHU's	0	12,843	18,049	12,835	12,835	0	12,835	12,835
Uplands AAHU's	0	27,182	27,475	13,149	13,149	0	13,149	13,149
All Watershed AAHU's	0	54,386	69,315	53,683	53,683	0	53,683	53,683

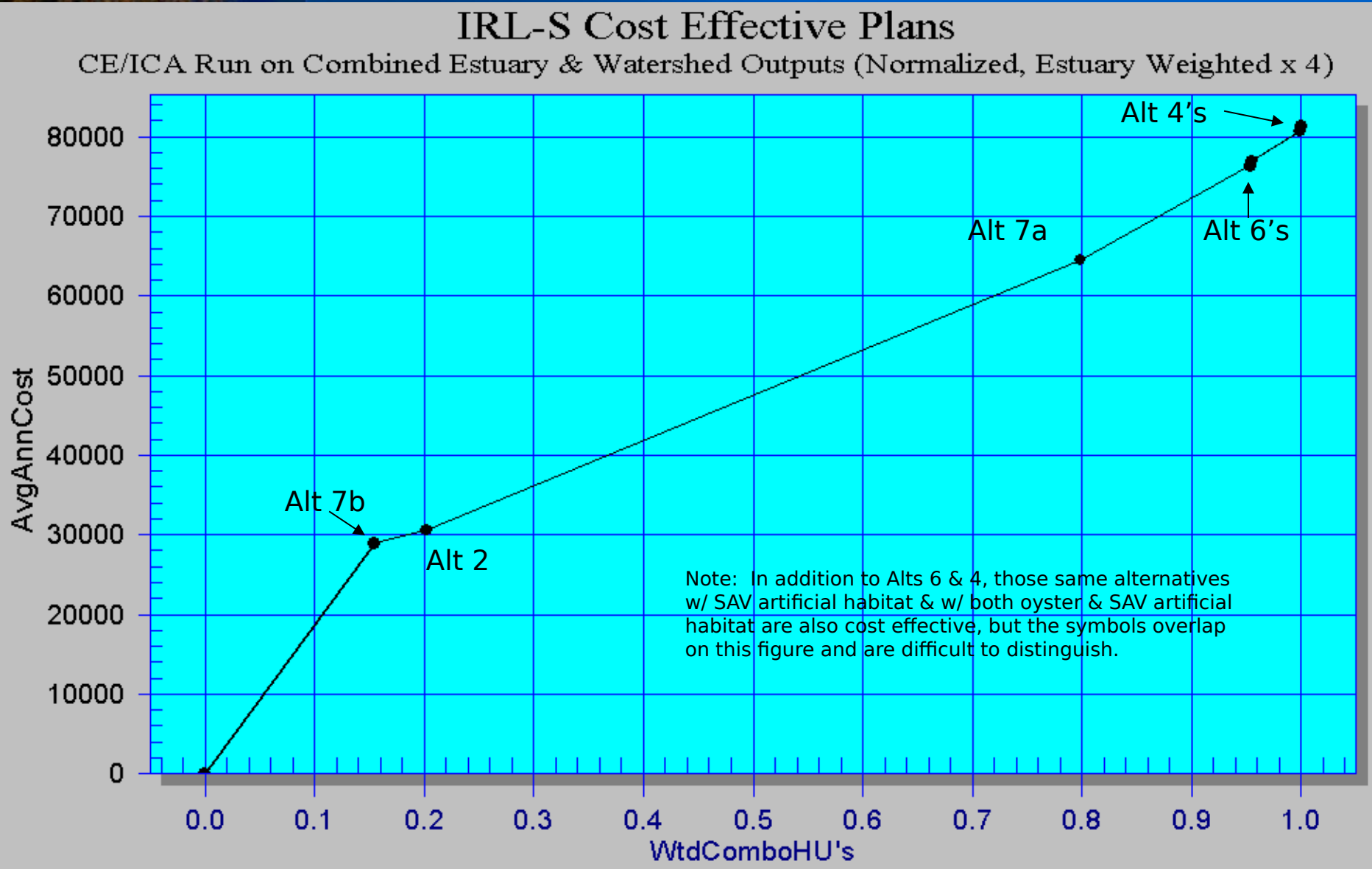
Cost Effectiveness Analysis Results: Combined Estuary HU's



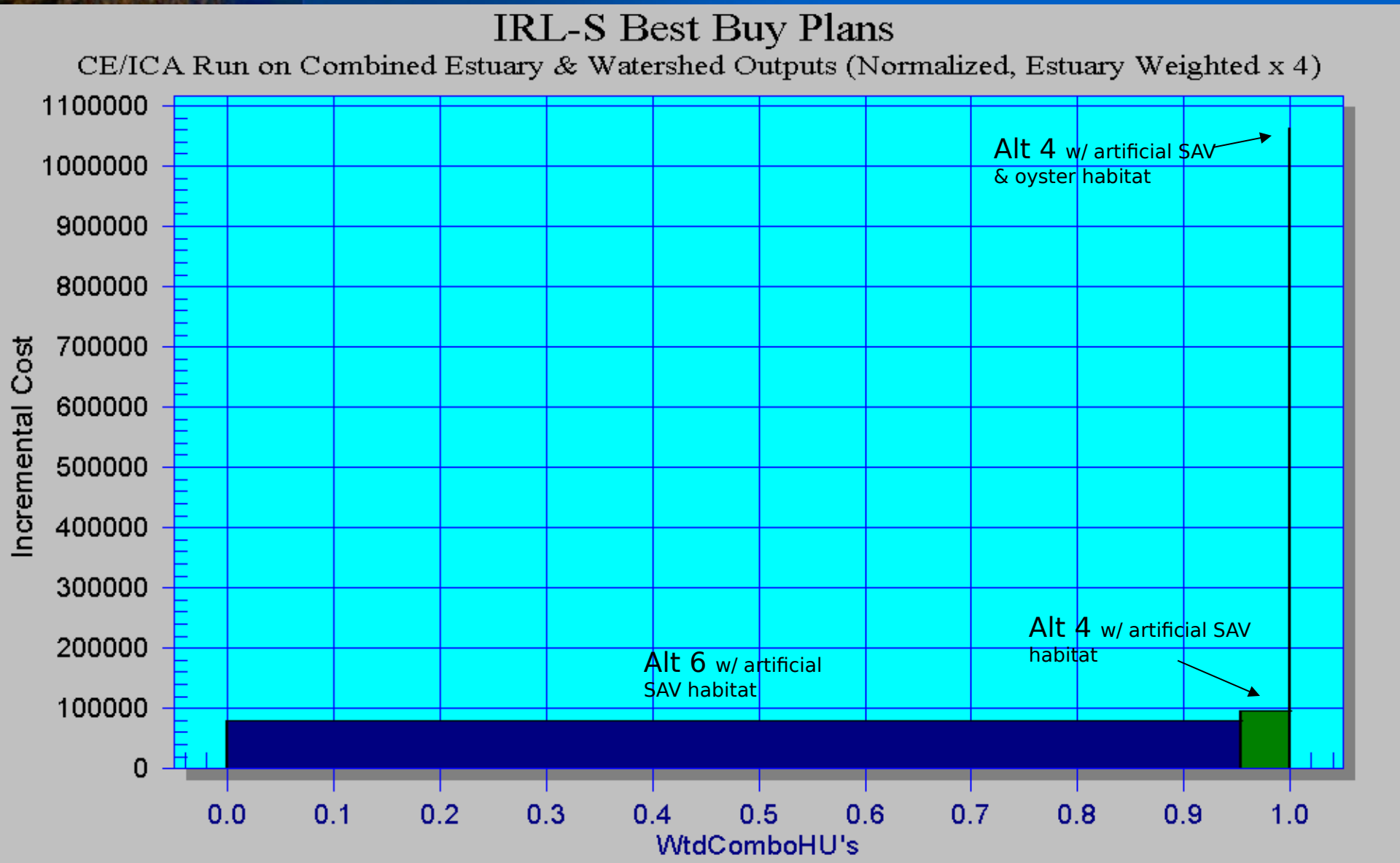
Cost Effectiveness Analysis Results: Combined Watershed & Estuary (Weighted) Index



Cost Effective Plans: Combined Watershed & Estuary (Weighted) Index



Incremental Cost Analysis Results: Combined Watershed & Estuary (Weighted) Index



Summary of CE/ICA Results

Output	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6 w/ SAV	Alt 6 w/ oyster & SAV	Alt 7a	Alt 7b
Total Estuary	Cost Effect				Cost Effect	Cost Effect & Best Buy	Cost Effect & Best Buy	
Total Watershed			Cost Effect & Best Buy					Cost Effect & Best Buy
Combined Index		Cost Effect	Cost Effect		Cost Effect	Cost Effect	Cost Effect	Cost Effect & Best Buy
Combined Weighted Index	Cost Effect		Cost Effect		Cost Effect & Best Buy	Cost Effect	Cost Effect	Cost Effect

Telling the Story: Rationale for Alt 6 w/ Artificial SAV & Oyster Habitat

- **Best meets planning objectives:**
  - **Restoration of estuarine aquatic ecosystem (≥ all other alts)**
  - **Increased spatial extent of watershed wetlands & uplands (secondary objective)**
- **Reasonably maximizes ecosystem outputs while passing tests of :**
  - **Cost effectiveness**
  - **(Best Buy) Incremental Cost Analysis (Alt 6 w/ artificial SAV)**
- **Provides 95% outputs of largest alternative (Alt 4), yet costs $53.4 million less than Alt 4**
- **Second lowest per unit costs of all alts in production of all outputs (only Alt 6 w/ just artificial SAV habitat is lower)**
- **Why include artificial oyster habitat?**
  - **Low total cost of artificial habitat increment ($630k aaec)**
  - **"Jump-start" in benefits provides immediate results**
  - **Builds public support by demonstrating "restoration" quickly**
  - **Strong inter-agency/ stakeholder support**

Indian River Lagoon – South Project Features

Water Storage & Water Quality Treatment

- 4 surface storage reservoirs - 135,000 acre-feet
- 4 STA's - 35,000 acre-feet
- 3 natural storage areas - 30,000 acre-feet

Upland & Wetland Habitat Improvement

- 3 restored natural areas - 92,000 acres
- Floodplain restoration - 3,100 acres

Estuarine Habitat Improvement

- 7.9 million cubic yards of muck removal
- Artificial reef & submerged aquatic vegetation

Indian River Lagoon - South
Initial Project Costs
(Oct 2003 price levels)

Project Feature	Construction Cost	Real Estate Cost	Total
Reservoirs + STA's	$329,756,000	$291,293,000	$621,049,000
Natural Storage Areas	$82,322,000	$385,952,000	$468,274,000
Muck remediation, artificial habitat, floodplain restoration	$83,353,000	$21,692,000	$105,045,000
Monitoring (construction)	$12,620,000		$12,620,000
Total (Including PMP cost of $300,000)	$508,352,000	$698,937,000	$1,207,289,000

Indian River Lagoon – South

Questions ?